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STREAM POLLUTION INVESTIGATION
NORTH PLATTE RIVER BASIN

PUBLIC HEALTH SERVICE
KANSAS CITY, MISSOURI

PREPARED FOR
BUREAU OF RECLAMATION
DENVER, COLORADO

APRIL 1950

PB 260 065

INTERIM REPORT OF STREAM POLLUTION INVESTIGATION
North Platte River Basin

April 1950

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INTERIM REPORT
OF
STREAM POLLUTION INVESTIGATION
NORTH PLATTE RIVER BASIN

Prepared for

DEPARTMENT OF INTERIOR

BUREAU OF RECLAMATION

REGION 7

DENVER, COLORADO

By

FEDERAL SECURITY AGENCY, PUBLIC HEALTH SERVICE

DIVISION OF WATER POLLUTION CONTROL

MISSOURI DRAINAGE BASIN

KANSAS CITY, MISSOURI

APRIL 1950

NORTH PLATTE RIVER BASIN INTERIM REPORT

INTRODUCTION

This interim report has been prepared as provided for in the memorandum of understanding respecting the joint program for stream pollution investigations of the North Platte River Basin, and is intended to supply an interpretation of currently available data for use by the Bureau of Reclamation in preparation of the comprehensive basin report. Included is a detailed survey of the North Platte River between Casper, Wyoming and Guernsey Reservoir where the extent, types, and major sources of pollution have already been determined. Recommendations regarding minimum stream flows in this stretch of the stream have been made, and estimates of possible benefits from increased flows are included.

Essential information for numerous portions of the Basin is at this time grossly incomplete. This report must therefore be considered as tentative in nature and subject to revision in the final report to be submitted at a later date.

CONCLUSIONS

The following conclusions are based upon preliminary studies of the North Platte River:

1. A very heavy pollutional load is received by the stream in the vicinity of Casper, Wyoming from the city and three nearby oil refineries. A fourth refinery at Glenrock, Wyoming also affects the stream.

2. Sanitary sewage from the City of Casper and wastes from the

refineries place a definite burden upon the streams as measured by oxygen depletion. In addition, refinery wastes contain chemical constituents such as phenolic compounds which may kill fishlife and preclude fishery habitat in this portion of the river.

3. The North Platte River recovers from the effects of this pollution by the time it reaches Guernsey Reservoir, except when shock or slug loads are placed upon the stream by the intermittent discharge of large quantities of trade wastes.

4. In the lower reaches, the North Platte River is not used for domestic water supply, therefore stream sanitation and fishlife constitutes the controlling factor insofar as pollution is concerned. In order to protect fishlife a minimum flow of 600 cubic feet per second of water would insure dilution of the organic and inorganic components of controlled industrial waste discharges sufficiently to prevent concentrations of toxic substances unfavorable to fishlife. This volume is required for dilution of the phenolic wastes and presupposes that primary treatment will be afforded the city sewage at Casper and the wastes from the four oil refineries.

5. Beet sugar refineries located at and below Torrington, Wyoming contribute gross pollution to the stream during the period of their operation. These factories must be studied during actual operations in order to permit proper evaluation of their waste problem.

6. Additional studies are required to properly evaluate the pollutional aspects of this stream. These studies are now in progress.

DESCRIPTION

The North Platte River originates in Northern Colorado on the

eastern slope of the Continental Divide, flows northward into Wyoming, and in the vicinity of Casper turns east for a distance of approximately 55 miles. The river then flows in a southeasterly direction to its confluence with the South Platte River.

The North Platte River has a total length of 680 miles. The Basin has a maximum east-west dimension of approximately 375 miles; a maximum north-south dimension of approximately 200 miles; and encompasses an area of 37,379 square miles. Of this amount 2,077 square miles, or 5.6 per cent is in Colorado; 25,541 square miles, or 68.3 per cent, is in Wyoming; while the balance of 9,761 square miles or 26.1 per cent is in Nebraska.

Sweetwater River and Laramie River are the two principal tributaries. Sweetwater River rises in Northwestern Wyoming and flows in an easterly direction to its confluence with the North Platte River at Pathfinder Reservoir. Laramie River rises in Northern Colorado and flows in a northerly and northeasterly direction to its confluence with the North Platte River at Fort Laramie, Wyoming.

The North Platte River has an average slope from the headwaters to Casper, Wyoming of 10.45 feet per mile, while from Casper to the mouth the average slope is 5.97 feet per mile. The highest temperatures are found in the lower altitudes in the eastern portion of the Basin. In this area the annual mean temperature is approximately 50°, while in the central and western areas the annual temperature is approximately 45° and 35° respectively.

During winter months, the river apparently freezes over completely, except in the vicinity of Casper where considerable quantities of warm wastes are discharged.

The average growing season in Nebraska is approximately 145 days, while in Wyoming it is about 125 days. Rainfall ranges from 18 inches in the eastern part of the Basin to 15 inches in the central and western part, with the greater portion of rainfall occurring during the summer season. Snowfall in the mountains increases precipitation in the western portion of the Basin. There are occasional severe local cloudbursts in the spring and early summer.

SURVEY METHODS

The present report represents a compilation and analysis of existing data supplemented by an intensive field study of short duration in the river reach from Casper, Wyoming to Guernsey Reservoir. Material available from other agencies has been reviewed and information pertinent to water pollution extracted. The Wyoming State Health Department has assisted in this activity. To obtain detailed information concerning the pollution of the North Platte River in the vicinity of Casper, a laboratory study was undertaken cooperatively with the State Health Department. Samples were collected from the North Platte River from a point above all pollution in the Casper area, from the various sources of industrial pollution in the Casper area, and from the river at various significant locations below Casper. The Chief of the Industrial Waste Section, Environmental Health Center, U. S. Public Health Service, Cincinnati, Ohio, assisted by the State Sanitary Engineer of Wyoming and personnel from the Basin Office, conducted industrial waste surveys of the four oil refineries in the vicinity of Casper.

It has not been possible to study the six sugar refineries since they were closed for the season prior to authorization of the study.

The sugar refineries will resume operations about October 1, for a period of approximately 90 days.

Municipal and Industrial Water Supply

Ground water is the principal source of municipal water for municipalities in the Basin, except for four small communities in the upper reaches of the North Platte River. These communities, Rock River, Hanna, Sinclair, and Encampment, Wyoming, obtain domestic water from the river. Casper, Wyoming has a dual water supply, using both well water and water from Elkhorn Creek.

Industries in the North Platte Basin obtain all or a portion of their water from the river, usually supplemented by auxiliary well supplies.

Irrigation and hydroelectric flows are controlled by 12 lakes and reservoirs. Flow from this storage influences industrial water supplies and sanitation of the stream. These reservoirs and lakes are: Seminoe, Pathfinder, Alcova, Guernsey, Wheatland, Lake Hattie, Hawk Springs, Cooper Lake and Goshen in Wyoming; Lake Alice, Lake Winters Creek, and Lake Minatare in Nebraska. Alcova and Guernsey Reservoirs are the principal regulating reservoirs on the stream. While these reservoirs are used to supply water to irrigation and hydroelectric developments, they also influence the water supply and sanitation aspects of the stream.

Pollution Contributed to Water Resources

Twenty-eight municipalities discharge sewage into surface streams. Five oil refineries and one sugar factory in Wyoming and five sugar factories and one oil refinery in Nebraska are the principal contributors of industrial pollution. Additional investigation will be necessary to

delineate the entire industrial waste picture.

Except for the City of Laramie on the Laramie River, only communities having populations of less than 1,000 have sewage treatment. All larger communities discharge untreated sewage directly to the water courses.

Wastes from the Sinclair Refinery at Sinclair, Wyoming are reported to be precluded from the North Platte River. The four oil refineries in the vicinity of Casper and Glenrock discharge refinery wastes to the North Platte River after preliminary treatment through oil separators designed to remove much of the excess oil in the water. Table No. 1 lists sources of pollution and indicates the large amount of waste entering the river from industrial sources. Laboratory tests indicate that the wastes from the three refineries at Casper have a population equivalent of approximately 42,000 persons. The Continental Refinery at Glenrock, approximately 30 miles downstream from Casper, has a population equivalent of 3,170. To date no study has been made of the oil refinery at Scottsbluff, Nebraska operated by the Consumers Cooperative Association.

Sugar factories place a tremendous load upon the stream through the discharge of untreated wastes. Wastes from the various sugar factories below Guernsey Reservoir are estimated to exceed 500,000 population equivalents. These wastes are discharged only during the fall and early winter seasons.

Laboratory Results

Laboratory findings corroborate field investigations indicating that this stream carries a very heavy pollution load in the vicinity of Casper, Wyoming, and indicate normal recovery of the stream before entering Guernsey Reservoir. During low flows it requires approximately 11 hours for this

stream to flow from Casper to Glenrock, Wyoming. At Glenrock the stream shows some recovery, but there is still evidence of significant pollution. At Douglas, Wyoming recovery of the stream is almost complete insofar as organic pollutants are concerned. Approximately 29 hours are required for the stream to flow from Casper to Douglas, Wyoming during periods of low flow.

Flow in the North Platte during the summer is much larger than during the winter, since releases are made from upstream reservoirs to provide irrigation waters downstream. These increased flows provide for greater dilution of the wastes discharged at Casper.

Field studies of oil refineries indicate that each refinery discharges continually small quantities of phenols, and intermittently discharge wastes which contain large quantities of phenols. Phenols and related compounds are toxic to fish in extremely small concentrations, and slug discharges may remove all fishlife.

Chemical tests indicate that there is a gradual increase in the dissolved mineral matter as the stream flows toward the mouth. Laboratory data indicate that at Guernsey Reservoir the stream has recovered to a point where the stream characteristics are similar to those prevailing above Casper. This is true except when shock or slug loads of industrial pollutants are discharged into the stream. At Guernsey Reservoir there is considerable water storage, which may be expected to form an effective block to hold back pollution and prevent it from adversely affecting the stream below the reservoir. In other words, by the time the water has passed through Guernsey Reservoir it has entirely recovered from the effects of normal pollution and should be satisfactory until additional pollution is received. This structure also insures considerable reaeration

and a high degree of oxygen saturation in released waters.

DISCUSSION

Studies to date indicate that an effective pollution barrier exists in the vicinity of Casper, Wyoming, making it impossible for game fish to exist in this stretch of the stream. This situation is created by two different conditions, combinations of which may adversely affect fishlife. The first of these is the pollution from Casper and the three nearby oil refineries. It is entirely feasible for these oil refineries to do a more effective job in reducing the strength of their wastes and to prevent the intermittent discharges of large amounts of toxic materials. The other factor is the very low flow in the North Platte River during the winter months. At the time of the laboratory study in February 1950 the flow at Casper was in the range of 65 cubic feet per second. The effects of pollution upon the fishlife in the stretch of the river would not be so severe if a greater amount of dilution water was available. Conversely if fish are to live in the stream during periods of low flow an excessively high degree of treatment must be given sewage wastes. This problem can best be solved by a reasonable degree of waste treatment, and the discharge of partially treated wastes into a stream having an adequate flow at all times.

There are six sugar factories and one oil refinery located on the river below Guernsey Reservoir and above Lewellen, Nebraska. These sugar factories, when in operation, place a very heavy burden upon the river. It will not be possible to make any satisfactory recommendations regarding this area until after these industries are studied.

Desirable Flows

In the North Platte Basin desirable flows throughout the entire year are not predetermined by the use of the water from the river for municipal water supplies. In this instance desirable flows are based upon the re-establishment of a desirable fish habitat, especially in that portion of the stream between Casper and the Guernsey Reservoir. As data regarding pollution from sugar refineries are not available, establishment of desirable flows below Guernsey Reservoir is not possible at this time.

In order to provide a suitable environment for fish, several factors are pertinent. This report is concerned only with pollution factors and includes consideration of an adequate quantity of oxygen and the absence of excessive concentration of toxic substances.

Investigation revealed that all refineries in the Casper area are discharging small amounts of phenols continuously, and occasionally discharge large volumes of solutions containing high concentrations of phenols and related compounds. Laboratory findings substantiate this continuous discharge of phenols from the refineries. M. M. Ellis, U. S. Department of Commerce, Bureau of Fisheries, has presented data indicating that 400 to 600 parts per billion of phenols in water may destroy trout in 500 minutes. No tolerance limits have been established indicating the amount of phenols which are safe for trout. There is reason to believe however that a concentration not to exceed 50 parts per billion would be compatible with fishery habitat. On this basis, using average laboratory results representing samples collected at Mystry Bridge in February, 1950, a minimum stream flow of 600 c.f.s. is indicated. With this stream flow oxygen requirements would be met providing all wastes

receive preliminary treatment prior to discharge to the stream. It would also be necessary to prevent the intermittent discharge of large quantities of the highly toxic phenolic wastes in order to insure a favorable fishery environment. With an increase in stream flow of this magnitude it can be anticipated that the barrier to fishlife in the vicinity of Casper will be eliminated, thus greatly enhancing the recreational values of the stream in this region.

ECONOMIC BENEFITS

The estimate of economic benefits to be derived from an increased flow in the North Platte River has been based upon the savings to industry if only primary treatment (35% removal) is required for industrial wastes in the Casper area. Benefits as discussed herein represent but one of the many benefits to be derived from the increased flow. Other benefits not considered at this time are improved fishing in this stretch of the river, an increase in the tourist trade due to better fishing, improved water for industrial purposes with a consequential decrease in the cost of industrial water conditioning, and the numerous other intangible benefits of a clean stream flowing through the region.

In determining the benefits to industries in the vicinity of Casper, Wyoming from greater flow in the stream, it has been assumed that a minimum of primary treatment of their industrial wastes will be provided which will remove approximately 35 per cent of the pollution load. If the stream flow is not increased it can be anticipated that secondary treatment, removing approximately 75 per cent of the pollution load, will be required.

Laboratory determinations indicate that the industrial wastes from the three oil refineries in the vicinity of Casper have a pollution load equivalent to a population of 42,000 persons. It has been assumed as a minimum figure that secondary treatment of industrial wastes would require a capital investment of approximately $5.00 per population equivalent greater than would be required for primary treatment. A total capital investment of $210,000, amortized in 20 years at 4% interest, would require annual charges of approximately $15,500. Operation and maintenance of secondary treatment facilities over that required for primary treatment, including the additional time for an operator for each of three plants, would cost approximately $3,500 per year, making a total estimated annual cost of $19,000 for secondary treatment over that required for primary treatment.

It seems reasonable therefore to assign an annual cost benefit of $19,000 to a sustained minimum flow of 600 c.f.s. at Casper, Wyoming for abatement of industrial pollution in this vicinity through dilution of partially treated sewage. This benefit would be in addition to other tangible and various intangible benefits resulting from the sustained flow.

Table 2

NORTH PLATTE RIVER

Anticipated Flows

Nearest Identification	Mileage of Gaging Station Above Mouth	Minimum Mean Monthly Flow, Second-Feet						Minimum Daily Flow Second-Feet
		Summer (1)			Winter (1)			
		2 Yr.	5 Yr.	10 Yr.	2 Yr.	5 Yr.	10 Yr.	
Northgate, Colo.	647.9	109	73	44	54	41	35	19
Saratoga, Wyo.	579.2	243	156	111	226	184	161	38
Seminoe Reservoir	530.0	184	110	65	244	214	200	70
Alcova Reservoir	442.0	1372	564	215	3	0.6	0	0
Below Casper	387.7	1585	647	202	76	64	59	26
Below Guernsey Res.	249.5	2285	1132	406	204	131	78	6
Below Whalen	240.5	399	161	90	49	10	6.2	0
Wyo-Nebr. State Line	199.2	755	644	348	392	312	248	21
Mitchell, Nebr.	184.0	246	135	84	608	410	251	45
Minatare	165.5	309	208	58	819	595	413	11
Bridgeport	141.5	442	295	90	1080	820	616	55
Lisco	112.8	401	275	73	1192	813	631	8
Oshkosh	95.2	379	246	55	1230	915	675	0
Lewellen	83.4	460	350	350	1437	1250	1200	0

(1) Summer Months - June, July, August September.

Winter Months - November, December, January, February.

NORTH PLATTE RIVER BASIN

Sewage and Sewage Treatment Data

State	Miles Above Mouth: North Platte River	Miles Above Mouth: Tributary	Population 1940	Estimated Population Connected to Sewer	Treatment (1)	Estimated Industrial Waste Population Equivalent	Estimated Sewered Population Equivalent (5): Untreated	Estimated Sewered Population Equivalent (5): Discharged
Wyo	579.2		810	900	P	(4)	900	450
	530.0							
Wyo		13.5	5,531	6,000	N	(4)	6,000	6,000
Wyo		7.5	604	850	N	(4)	850	850
	502.0							
Wyo		15.5	1,127	-	-	0	0	0
	494.7							
Wyo		79.0	338	450	N	(4)	450	350
	396.3							
Wyo		8.0	-	50	S	0	50	50
Wyo	396.0		-	120	P	0	120	60
Wyo	396.0		17,964	25,000	N	42,130	67,130	67,130
Wyo	390.0		206	350	N	0	350	350
Wyo	366.1		1,014	1,250	N	3,170	4,420	4,420
Wyo	325.0		2,205	2,500	N	(4)	2,500	2,500
	249.5							
Wyo		4.0	500*	300	S	(4)	300	150
Wyo		3.5	179	250	S	(4)	250	125
Wyo	249.5		603	700	N	(4)	700	700
	232.2							
Wyo		135.0	10,627	14,000	P	(4)	14,000	10,000
		26.6						
Wyo		8.8	2,110	2,500	N	(4)	2,500	2,500
	217.2							
Wyo		2.6	428	550	N	(4)	550	550
Wyo	208.5)		505	-	-	-	-	-
Wyo	208.5)		930	-	-	-	-	-
Wyo	208.5)		2,344	3,500	N	152,000	155,500	155,500

Table 1

NORTH PLATTE RIVER BASIN

Sewage and Sewage Treatment Data

Municipality	State	Miles Above Mouth: North Platte River	Miles Above Mouth: Tributary	Population 1940	Estimated Population Connected to Sewer	Treatment (1)	Estimated Industrial Waste Population Equivalent	Estimated Population Untreated
North Platte River								
Saratoga	Wyo	579.2		810	900	P	(4)	900
Sugar Creek		530.0						
Rawlins	Wyo		13.5	5,531	6,000	N	(4)	6,000
Sinclair	Wyo		7.5	604	850	N	(4)	850
No Name Creek		502.0						
Hanna	Wyo		15.5	1,127	-	-	0	0
Medicine Bow River		494.7						
Medicine Bow	Wyo		79.0	338	450	N	(4)	450
Casper Creek		396.3						
Casper A.B.	Wyo		8.0	-	50	S	0	50
(Bur.of Rec.Housing								
(Project	Wyo	396.0		-	120	P	0	120
Casper	Wyo	396.0		17,964	25,000	N	42,130	67,130
Evansville	Wyo	390.0		206	350	N	0	350
Glenrock	Wyo	366.1		1,014	1,250	N	3,170	4,420
Douglas	Wyo	325.0		2,205	2,500	N	(4)	2,500
Dry Creek		249.5						
Sunrise	Wyo		4.0	500*	300	S	(4)	300
Hartville	Wyo		3.5	179	250	S	(4)	250
Guernsey	Wyo	249.5		603	700	N	(4)	700
Laramie River		232.2						
Laramie	Wyo		135.0	10,627	14,000	P	(4)	14,000
Rock Creek			26.6					
Wheatland	Wyo		8.8	2,110	2,500	N	(4)	2,500
Rawhide Creek		217.2						
Lingle	Wyo		2.6	428	550	N	(4)	550
(West Torrington	Wyo	208.5)		505	-	-	-	-
(South Torrington	Wyo	208.5)		930	-	-	-	-
(Torrington	Wyo	208.5)		2,344	3,500	N	152,000	155,500

NORTH PLATTE RIVER BASIN

Sewage and Sewage Treatment Data

State	Miles Above Mouth: North Platte River	Miles Above Mouth: Tributary	Population 1940	Estimated Population Connected to Sewer	Treatment (1)	Estimated Industrial Waste Population Equivalent	Estimated Sewered Population Equivalent (5): Untreated	Estimated Sewered Population Equivalent (5): Discharged
	193.6							
Nebr		4.0	672	120	N	(4)	120	120
Nebr	191.3		877	700	N	(4)	700	700
Nebr	184.0		2,181	2,000	N	(4)	2,000	2,000
Nebr	173.8		12,057	7,000	N	(4)	7,000	7,000
Nebr	173.0		3,104	2,200	P	(4)	2,200	1,100
Nebr	165.5		1,125	700	N	(4)	700	700
Nebr	165.5		145	150	S	(4)	150	150
	149.5							
Nebr		4.7	2,121	1,500	N	(4)	1,500	1,500
Nebr	141.5		1,520	1,300	N	(4)	1,300	1,300
Nebr	127.0		344	150	N	(4)	150	150
	108.0							
Nebr		41.0	203	-	-	(4)	-	-
	95.2							
Nebr		1.0	910	1,000	N	(4)	1,000	1,000
	Subtotals:							
		Wyoming	48,025	59,270				
		Nebraska	25,259	16,820				
	Totals		73,284	76,090				

(1) Treatment - P - Primary
S - Secondary
N - None

(2) * Population figure - 1947 Rand McNally Estimate

(3) ** Seasonal Industrial Discharge

(4) Additional investigation required

(5) Does not include industrial pollution except as indicated

Note: Form 1156 states no pollution passing through Seminoe, Pathfinder and Alcova Reservoirs.

Table 1
(cont'd.)

NORTH PLATTE RIVER BASIN

Sewage and Sewage Treatment Data

Municipality	State	Miles Above Mouth: North Platte River	Miles Above Mouth: Tributary	Population 1940	Estimated Population Connected to Sewer	Treatment (1)	Estimated Industrial Waste Population Equivalent	Estimated Population Untreated
Horse Creek		193.6						
Lyman	Nebr		4.0	672	120	N	(4)	120
Morrill	Nebr	191.3		877	700	N	(4)	700
Mitchell	Nebr	184.0		2,181	2,000	N	(4)	2,000
Scottsbluff	Nebr	173.8		12,057	7,000	N	(4)	7,000
Gering	Nebr	173.0		3,104	2,200	P	(4)	2,200
Minatare	Nebr	165.5		1,125	700	N	(4)	700
Melbeta	Nebr	165.5		145	150	S	(4)	150
Bayard Canal		149.5						
Bayard	Nebr		4.7	2,121	1,500	N	(4)	1,500
Bridgeport	Nebr	141.5		1,520	1,300	N	(4)	1,300
Broadwater	Nebr	127.0		344	150	N	(4)	150
Rush Creek		108.0						
Gurley	Nebr		41.0	203	-	-	(4)	-
Lost Creek		95.2						
Oshkosh	Nebr		1.0	910	1,000	N	(4)	1,000
Subtotals:								
			Wyoming	48,025	59,270			
			Nebraska	25,259	16,820			
Totals				73,284	76,090			

(1) Treatment - P - Primary
S - Secondary
N - None

(2) * Population figure - 1947 Rand McNally Estimate

(3) ** Seasonal Industrial Discharge

(4) Additional investigation required

(5) Does not include industrial pollution except as indicated

Note: Form 1156 states no pollution passing through Seminoe, Pathfinder and Alcova Reservoirs.